Claims

1. A shaped resistive heater comprising a resistive element and an electrically insulating element, wherein said heater has a fixed, non-planar shape that is conformal to at least a portion of an object to be heated, wherein said heater is not adhered to said object.

2. The heater of claim 1, comprising two electrically insulating elements, wherein said resistive element is disposed between said electrically insulating elements.

3. The heater of claim 1, further comprising a power supply that is electrically coupled to said resistive element, wherein the application of current from said power supply results in the production of heat by said resistive element.

4. The heater of claim 1, further comprising a thermal barrier element.

5. The heater of claim 4, wherein said thermal barrier element comprises zirconium oxide.

6. The heater of claim 1, wherein said electrically insulating element comprises aluminum oxide, silicon dioxide, or mica.

7. The heater of claim 1, wherein said resistive element comprises a Ni-Cr alloy, titanium (Ti), silicon (Si), aluminum (Al), zirconium (Zr), cobalt (Co), nickel (Ni), iron (Fe), FeCrAl, or alloys thereof.

8. The heater of claim 1, wherein said resistive element is formed by thermally spraying, machining, casting, sintering, PVD, or CVD.

9. The heater of claim 1, further comprising one or more additional resistive elements.

10. The heater of claim 1, further comprising one ore more thermal sensors.

11. The heater of claim 10, wherein said thermal sensors comprise an array of thermocouples.

12. A method of heating an object, said method comprising the steps of:

a) providing a shaped resistive heater comprising a resistive element and an electrically insulating element, wherein said heater has a fixed, non-planar shape that is conformal to at least a portion of said object, wherein said heater is not adhered to said object;

b) placing said heater into conformal contact with said object; and

c) applying current to said resistive element to produce heat.

13. The method of claim 12, further comprising the step of (c) replacing said shaped heater with a second shaped heater after one or more applications of current to said resistive element.

14. A mold comprising:

a) a shell comprising a cavity side and a back side, wherein said cavity side defines a mold cavity;

b) a resistive heater comprising a resistive element and an electrically insulating element, wherein said heater is shaped to conform to at least a portion of said back side of said shell, and said heater is in conformal contact with said back side of said shell; and

c) a housing capable of physically supporting said shell and said heater, wherein said heater is disposed between said shell and said housing.

15. The mold of claim 14, wherein said resistive heater in step (b) is adhered to at least a portion of said back side of said shell.

16. The mold of claim 14, wherein said resistive heater in step (b) is not adhered to said shell.

17. The mold of claim 14, further comprising a thermal barrier element disposed between said heater and said housing.

18. The mold of claim 14, further comprising a cooling jacket.

19. The mold of claim 14, wherein said resistive heater is coupled to a power supply, wherein application of current from said power supply results in production of heat by said resistive element.

20. The mold of claim 14, wherein an electrically insulating element is disposed between said resistive element and said back side.

21. The mold of claim 14, wherein an electrically insulating element is disposed between said housing and said resistive element.

22. The mold of claim 14, further comprising one or more additional heaters.

23. The mold of claim 22, wherein said one or more additional heaters are in conformal contact with said back said.

24. The mold of claim 22, wherein at least a portion of said heater of (b) is disposed between at least a portion of said one or more additional heaters and said back side.

25. The mold of claim 14, further comprising one or more thermal sensors.

26. The mold of claim 25, wherein said thermal sensors comprise an array of thermocouples.

27. A method of making a molded product, said method comprising the steps of:

a) providing a mold comprising:

i) a shell comprising a cavity side and a back side, wherein said cavity side defines a mold cavity;

ii) a resistive heater comprising a resistive element and an electrically insulating element, wherein said heater is shaped to conform to at least a portion of said back side of said shell, and said heater is in conformal contact with said back side of said shell; and

iii) a housing capable of physically supporting said shell and said heater, wherein said heater is disposed between said shell and said housing;

b) heating said resistive heater by the application of current; and

c) injecting a material to be molded into said mold, wherein said heated resistive heater regulates the solidification of said material, thereby forming said molded product.

28. The method of claim 27, wherein said mold further comprises a cooling jacket.

29. The method of claim 27, further comprising step (d) cooling said material in said mold.

30. The method of claim 27, wherein said material is a thermoplastic material, thermoset material, metal, ceramic, cermet, glass, or combination thereof.

31. A method of making a mold, said method comprising the steps of:

a) providing a shell comprising a cavity side and a back side and a housing capable of physically supporting said shell, wherein said cavity side defines a mold cavity; and

b) depositing a resistive element on at least a portion of said back side, wherein when said shell is supported by said housing, said resistive element is disposed between said shell and said housing.

32. The method of claim 31, further comprising the steps of:

c) forming an electrically isolated, resistive heater path in said resistive element; and

d) connecting said resistive heater path of step (c) to a power supply, thereby fabricating a resistive heater.

33. The method of claim 32, wherein said forming in step (c) is by micromachining, microabrading, laser cutting, chemical etching, or e-beam etching.

34. The method of claim 31, further comprising the step, prior to step (b), of depositing an electrically insulating element on at least a portion of said back side of said shell.

35. The method of claim 31 further comprising the step of:

c) depositing a thermal barrier element on at least a portion of said resistive element.

36. The method of claim 31, wherein said shell is produced by electroplating, electroless deposition, molding, spray forming, machining, CVD, or PVD.

37. A method of making a mold, said method comprising the steps of:

a) providing a shell comprising a cavity side and a back side and a housing capable of physically supporting said shell, wherein said cavity side defines a mold cavity; and

b) forming a resistive heater that has a shape that is conformal to at least a portion of said back side, wherein when said shell and said resistive heater are supported by said housing, said resistive element is disposed between said shell and said housing.

38. The method of 37, wherein said forming in step (b) comprises:

i) depositing a resistive element on at least a portion of an object replicating at least a portion of the shape of said back side; and

ii) removing said resistive element from said object.

39. The method of 38, further comprising depositing an electrically insulating element on at least a portion of said object prior to step (i), wherein said removing in step (ii) also removes said electrically insulating element.

40. The method of 38, further comprising depositing an electrically insulating element on at least a portion of said resistive element, before or after step (ii).

41. The method of 38, further comprising depositing a thermal barrier element on at least a portion of said resistive element, before or after step (ii).

42. The method of 38, wherein said depositing comprises thermal spraying.

43. The method of 37, wherein said forming in step (b) comprises:

i) providing a second shell having a shape conformal to at least a portion of said back side; and

ii) depositing a resistive element on said second shell.

44. The method of 43, further comprising depositing an electrically insulating element on at least a portion of said second shell prior to step (ii).

45. The method of 43, further comprising depositing an electrically insulating element on at least a portion of said resistive element.

46. The method of 43, further comprising depositing a thermal barrier element on at least a portion of said resistive element.

47. The method of 43, wherein said depositing comprises thermal spraying.